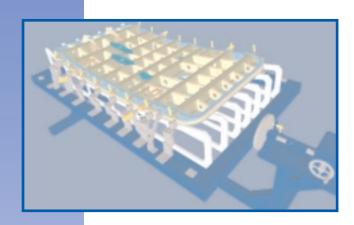


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C-17 Design, **Manufacturing and Producibility Simulation (DMAPS)**



DESCRIPTION

Boeing Aircraft and Missiles, St. Louis, (heritage McDonnell Aircraft), over the past several years, has created a product development process referred to as Design, Manufacture, and Producibility Simulation (DMAPS). It revolves around an integrated CAD/CAM systems implementation and solid model product definition. Master solid models are created once and used by all other processes and applications needed to

SUMMARY

PROBLEM:

■ In order to meet a program goal of reducing aircraft cost by 25 percent in four years, a method was needed to significantly reduce the cost and development cycle time of C-17 affordability initiatives while assuring first article quality.

SOLUTION:

■ An innovative process is being implemented called Design, Manufacturing, and **Producibility Simulation** (DMAPS). It facilitates design definition and provides an environment that makes integrated product and process development (IPPD) a reality. DMAPS blends traditional computeraided design and computer-aided manufacturing (CAD/CAM) tools with simulation and virtual reality (VR) technology. DMAPS has been shown to reduce development cost and cycle time by 50 percent, and improve first article quality by 66 percent as measured by after-release engineering changes and non-conformance escapes.



create the design-to, buy-to, build-to, and support-to data packages. A variety of design, analysis, and manufacturing applications has been interfaced to the product data to automate the development process. Feature-based design is used to allow rapid design changes resulting from design optimization and analysis. After product features have been "frozen," the design can be sent out to suppliers for bid while final dimensions are determined. Final product definition is released concurrently with supplier contract award, thus, significantly reducing the time to receive the manufactured component. Designs are fully defined by the master solid model and traditional 2D drawings are not created. This reduces engineering effort by approximately 30 percent.

Perhaps the most innovative feature of DMAPS is the application of simulation and virtual reality (VR) software. Solid models of the product, tooling, machine tools, and facility can be used to simulate everything from process/factory flow to CNC machine programming. VR offers the ability view the complete product design in a 3D virtual environment. For example, a 3D model of the C-17, with its 220,000 elemental parts and components, can be viewed in an interactive session --something that is impossible to do on traditional CAD systems. This offers an unprecedented environment to allow downstream functions, i.e., planning, fabrication, assembly, operations and maintenance, to explore the design and provide input prior to final design release.

This makes IPPD a reality! Solid model representation allows non-engineering personnel to comprehend and review the design easily. Analysis applications can be used to identify interference and evaluate human factor interfaces. VR can be used to develop simulation-based work instructions. Mechanics are able to visually review the assembly process, showing placement and indexing of parts and tools, drilling of holes and installation of fasteners. This "virtual" learning reduces labor required to perform the task the first time in the factory and for all subsequent assemblies, substantially reducing production cost.

In November of 1998, Boeing and the C-17 SPO agreed to pilot DMAPS on several C-17 projects. Procedures have been developed to support the new "define" process, and DMAPS tools have been implemented. The Low Cost Troop Door was one of the first pilot projects. The door has been redesigned, solid models released, parts manufactured and inspected by supplier, and delivered for assembly. A serious tooling problem was identified during assembly simulation (shown in above graphic), which resulted in jig-lock of the door assembly. This allowed the tooling design to be modified prior to its release and fabrication. The new door design incorporates several designs for manufacture and assembly (DFMA) concepts and has reduced the number of parts by 60 percent and the number of fasteners by 30 percent. Assembly labor has been reduced by 40 percent and span time by 30 percent.

DMAPS is significantly enhancing the SPO's ability to review product designs. Equipment and software is being procured and installed at WPAFB, OH, which allows the SPO to participate in VR design reviews held at Boeing C-17 design locations. Traditional development milestones such as preliminary and critical design reviews (PDR/CDR) are shorter and more effective because the time is spent discussing issues and not trying to understand volumes of engineering drawings. In addition, there is an exciting potential for the application of DMAPS solid models and VR in maintenance, operation, and sustainment of the weapon system. These areas are now just being explored.

DMAPS represents a step improvement in the C-17 product development process. Boeing's goal is to reduce system acquisition and operation and support costs by 50 percent.

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